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FOREST PEST MANAGEMENT

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Forest Pest Management
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BIOLOGICAL EVALUATION

R2-88-4

Western Spruce Budworm Infestation of
Dolores River Drainage

1988

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EXPERIMENT STATION

INTRODUCTION

During July 1988, a Western Spruce Budworm (WSB) infestation was discovered in the Dolores River drainage of the San Juan National Forest. Private landowners and Dolores Ranger District personnel became concerned. Subsequently, in response to a request for assistance through District Ranger Leonard Atencio, Entomologist Ken Lister, of Forest Pest Management in Denver conducted a biological evaluation.

Field work was conducted during visits made during the first and third weeks of August to collect data and branch samples. Moth flight was occurring during the first week, so branch collections were delayed until the second visit, August 16-18, 1988.

Egg mass density is used to monitor and forecast defoliation. Some outbreaks are curbed by natural factors such as predation, parasitism, and adverse weather; whereas others continue to expand causing widespread damage, in the form of top kill and tree mortality. Egg mass density is our most reliable factor used to decide for or against control measures.

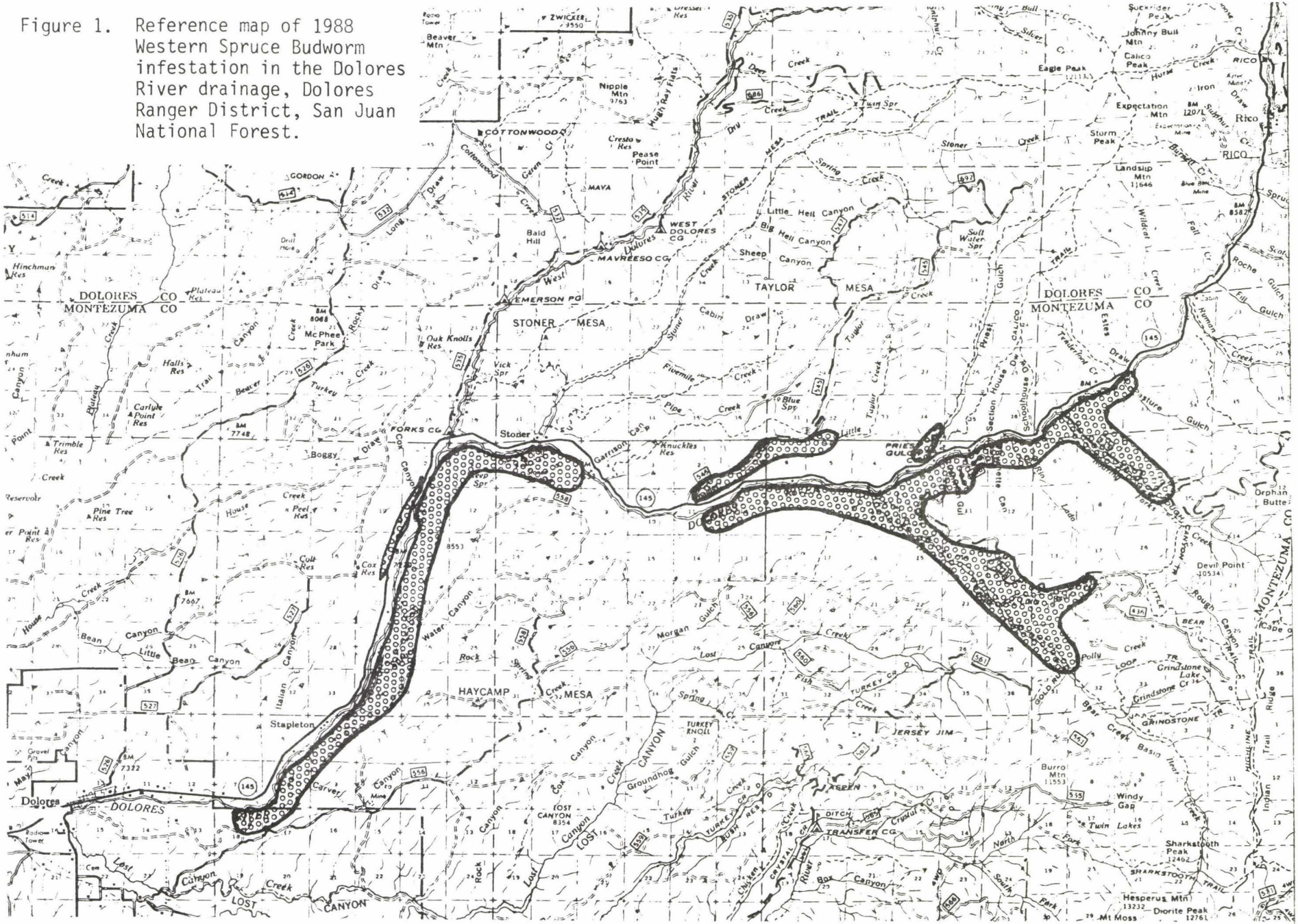
The intent of this evaluation is to provide an assessment of current biological conditions and expected trends of the infestation.

GENERAL DESCRIPTION OF INFESTED AREA

The Dolores River drainage can be characterized as being forested with aspen and a mix of conifers occurring as pure and mixed species stands. Overall, aspen type is approximately 50 percent. At the headwaters, spruce-fir dominates, but with some interspersed aspen; whereas, in the lower part of the drainage, aspen dominates with some conifer patches interspersed. About one third of the way down drainage, or about 6 miles down river from Rico, Colorado, Douglas-fir begins especially on north slopes extending to Dolores, Colorado. In the middle area, Douglas-fir also occurs to a limited extent on south slopes, frequently mixed with ponderosa pine.

The western spruce budworm infestation is closely aligned with the occurrence of Douglas-fir. Defoliation occurs primarily on Douglas-fir, but does also occur on Engelmann spruce, especially in drainage bottoms, and to a limited extent at the higher elevations of tributary drainages. Substantial defoliation was observed on subalpine fir at the upper elevations of the tributaries of Bear Creek and Roaring Forks Creek. Defoliation occurred up secondary drainages as follows; Bear Creek, about 6 miles, Roaring Forks Creek, 3 miles, Taylor Creek, 3 miles, and Priest Gulch, almost 1 mile. West Dolores was not accessible due to road construction and so the infestation status there is unknown. The infested areas are displayed on the map included, Figure 1. As mapped, it is estimated the gross infested area covers about 11,000 acres.

Figure 1. Reference map of 1988 Western Spruce Budworm infestation in the Dolores River drainage, Dolores Ranger District, San Juan National Forest.



TECHNICAL INFORMATION

Insect: Western spruce budworm, Christoneura occidentalis Freeman

Hosts: Douglas-fir, Pseudotsuga menziesii (Mirb.) Franco
Subalpine fir, Abies lasiocarpa (Hook.) Nutt
Engelmann spruce, Picea engelmannii Parry ex Engelm.
Blue spruce, Picea pungens Engelm.

Life History: Western spruce budworm has one generation per year.

Stage	Time	Location on Host
Egg	August	On needles
Small larvae	Over winter	In hibernaculum (silken cocoons) on branches and bole
Larger larvae	June-July	Buds, strobili and needles
Pupae	July	In webbing and foliage
Adults	August	In flight or at rest on tree crowns

Infestation evidence:

1. Partially eaten foliage with silken webbing and bits of excrement.
2. Developing buds are mined with silken webbing and bits of excrement.
3. Larvae feeding on new shoots.
4. Tree crowns turn brown, especially the tops.
5. Tree tops appear dead (no foliage) after several years of defoliation.

METHODS

Douglas-fir trees were sampled at four accessible areas. The number of trees sampled and sites were as follows: 52 at Priest Gulch, 28 at Taylor Creek, 44 at Burnette Canyon, and 34 at Roaring Forks Creek. At each tree, one 24 inch branch tip was removed from midcrown. The foliage samples were bagged, labeled, and transported to the laboratory. In the lab, shoot length and defoliation was measured for the last two years, 1988 and 1987. After the measurements were completed, the sample was examined thoroughly and all egg masses new and old were extracted. A stereoscope was used to separate new from old egg masses. The number of new egg masses was used to predict defoliation for next year.

Egg mass density, classes, and expected defoliation are displayed in Table 1. These classes are from McKnight, et al. (1970), and were refined by Linnane (1978) based on four years of data.

Table 1. Defoliation Prediction Classes for Western Spruce Budworm Egg Mass Sampling in the Rocky Mountain Region.

Class	Mean Number of Egg Masses Per Square Meter of Foliage	Defoliation Prediction 1/
1	1.6 or less	Undetectable
2	1.7 to 40.00	Light
3	10.0 or more	Moderate to Heavy

1/ Defoliation expected on new growth of Douglas-fir or White fir only.

Undetectable	0-10%
Light	10-35%
Moderate	36-65%
Heavy	66-100%

RESULTS AND OBSERVATIONS

The density of new egg masses per square meter (M^2) of Douglas-fir foliage from this survey, for all trees, was calculated to be 1.63. This data was obtained from the examination of 158, 24-inch branch tips amounting to a cumulative total of 37.61 M^2 of foliage. From these data it is predicted the defoliation in 1989 will be light (10 to 35%). Data for the individual sample areas is in Table 2.

Table 2. Results of the 1988 Western Spruce Budworm Survey of the Dolores River Drainage with Defoliation Predictions for 1989.

Area	Number of Branch Samples	Volume of Foliage M^2	Number of New Egg Masses	$\bar{x}$ Egg Masses per M^2	Defoliation Prediction
Priest Gulch	52	11.22	17	1.52	Undetectable
Burnette Canyon	44	10.65	25	2.35	Light
Taylor Creek	28	6.19	5	.81	Undetectable
Roaring Forks Creek	34	7.96	14	1.76	Light
All Area Summary	158	37.61	61	1.63	Light

Defoliation measured from the midcrown branches was 33.6 ± 18.3% for 1988 and 22.8 ± 12.1% in 1987. The mean shoot length was 2.13 ± .69 for 1988 and 1.84 ± .41 in 1987. Table 3 contains the defoliation and shoot length data of the individual sample areas. The increase found for percent defoliation and shoot length in 1988 were significant when tested at the 99.9% confidence level, but there was no correlation. This means there was an increase in the budworm population in 1988 from 1987.

Table 3. Summary of the Defoliation and Shoot Measurements for the Years of 1988 and 1987 from the Branch Tips Collected for this Egg Mass Survey.

Area	Percent Defoliation		Shoot Length (Inches)	
	1988	1987	1988	1987
Priest Gulch	42.2 ± 17.3	28.1 ± 11.1	2.06 ± .73 S	1.80 ± .38
Burnette Canyon	35.2 ± 15.3	23.5 ± 11.5	2.07 ± .73 S	1.83 ± .41
Taylor Creek	38.8 ± 16.9	25.9 ± 12.2	2.62 ± .42 S	2.13 ± .29
Roaring Forks Creek	14.2 ± 7.3	11.4 ± 5.7	1.91 ± .41 S	1.67 ± .29
Mean's	33.6 ± 18.3	22.8 ± 12.1	2.13 ± .69	1.84 ± .41

During the first field visit August 2-4, several observations were made: (1) Cool, cloudy weather with afternoon showers was occurring and had been for at least a week, according to personnel of the Dolores District. (2) A large population of moths was present, mostly at rest in the tree crowns. (3) Parasitic insects were observed and some were collected by sweep-netting the crowns of Douglas-fir trees. (4) Evidence of defoliation prior to 1987 was very low.

During the second field visit August 16-18, two observations should be mentioned. (1) The moth flight had ended. (2) The cool, cloudy weather with afternoon showers was still occurring.

No attempt was made to survey parasites or predators. However, upon observing some diptera (flies) and ichneumonids (small parasitic wasps), some specimens were collected. Since the whole issue of understanding the role of parasites is vague, only a mentaion of the types collected is presented. They were:

Diptera (1)
Hymenoptera
Ichneumonidae
Mesochorinae (1)
Porizontinae (1)
Ephialtinuae
Glypta sp.(2)(probably fumiferanae)
Itoplectis (1)

DISCUSSION

Egg mass sampling plots were planned and established in the mid 1960's throughout Region Two in Douglas-fir having any current or past defoliation incidence. The Dolores River drainage was included with plots in Scotch Creek and Priest Gulch. The plots were sampled until 1969 and have not been sampled because of the low level of WSB activity until this year.

Parasites, predators and adverse weather usually combine causing considerable mortality, especially to endemic or low populations, but are often inadequate when a population is epidemic. Adverse weather probably has the greatest influence in population changes of the three afore-mentioned factors.

Considering the egg mass density found in this survey and the observations made, it is believed, the adverse weather during moth flight inhibited egg deposition in 1988. It is highly probable the adverse weather prevented population increase for 1989.

ALTERNATIVES

Aerial Application of Insecticides

An Environmental Assessment (EA) of the western spruce budworm outbreak of the Rocky Mountain Region was prepared in 1982 (USDA Forest Service, 1982). The application of insecticides was considered in the EA. The Decision Notice of that document explains that "Direct Suppression Alternatives with Aerial Applications of either Chemical or Microbial Insecticides, were not adopted because of concerns over effectiveness in suppressing WSB, high cost of alternatives, and public opinion of aerial insecticide spraying."

Ground Application of Insecticides

Microbial Insecticide: Bacillus thuringiensis Berliner (BT) is a naturally occurring bacterium produced and registered for suppression of WSB. It is a specific insecticide for Lepidopterous pests having no demonstratable effects to non-target organisms. It can be applied with a truck-mounted hydraulic sprayer quite successfully to high value trees, i.e. campsites, ornamentals, and etc. It is often used in environmentally sensitive areas including areas immediately adjacent to lakes and streams. Foliage protection may be less than with chemicals.

Chemical Insecticides: Of the several chemical insecticides registered for use against WSB, two are recommended by Forest Pest Management. They are carbaryl and acephate. They are broad spectrum insecticides which will affect non-target insects. Aquatic insects are readily affected. Use of these chemicals would necessitate the use of mitigating measures to prevent entry to open water. They can produce good foliage protection with proper, timely application.

Continue Current Management

This is the no action alternative. The WSB infestation would run its natural course and eventually collapse as a result of natural factors.

Silvicultural Management

The impact of WSB infestations can be minimized by using silvicultural strategies. Intermediate cuttings, commercial, or pre-commercial which regulate stocking to release or maintain tree growth is one strategy. Another is regeneration harvest when infestations are endemic.

RECOMMENDATIONS

Aerial spraying is not recommended in 1989 due to the low egg mass density of $1.63/M^2$. Ground application of insecticide may be warranted on an individual tree basis in some locations depending upon the trees' value.

Forest Pest Management should continue to evaluate the WSB infestation in 1989 with more emphasis given to the role of parasitism in the population.

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